



neoResus

The Victorian Newborn Resuscitation Project



Operating & troubleshooting a T-piece device: Neopuff™ Infant Resuscitator

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Aims & objectives

- This presentation has been designed to assist you to:
 - Assemble the Neopuff™ T-piece device
 - Set the recommended flow rate & pressures
 - Operate the Neopuff™ T-piece device
 - Troubleshoot the Neopuff™ T-piece device
- We suggest that you print a copy of this presentation and have the Neopuff™ at hand to practice each action.

Manual ventilation devices

The Australian Resuscitation Council (ARC) & the New Zealand Resuscitation Council (NZRC) guidelines state:
“A T- piece device, a self inflating bag and a flow inflating bag are all acceptable devices to ventilate newborn infants either via a face mask or endotracheal tube”.

(ARC & NZRC, 2010, Guideline 13.4)

T-piece device (e.g. Neopuff™ Infant Resuscitator)

Advantages of using a T-piece device

- The operator sets the peak inspiratory pressure (PIP) & positive end expiratory pressure (PEEP).
- The T-piece device will not deliver PIP or PEEP/CPAP above the set pressures if the flow remains constant.
- The PIP & PEEP are displayed on the manometer.
- The operator can control the length of the inspiratory time by varying the duration of occlusion of the PEEP cap.

Positive end expiratory pressure

T-piece device

Can provide CPAP or PEEP

Self inflating bag

Does not deliver CPAP or PEEP*

* Unless a PEEP valve has been fitted

Why is PEEP so important?

- It assists with lung expansion
- It helps to establish functional residual capacity
- It leads to improved oxygenation



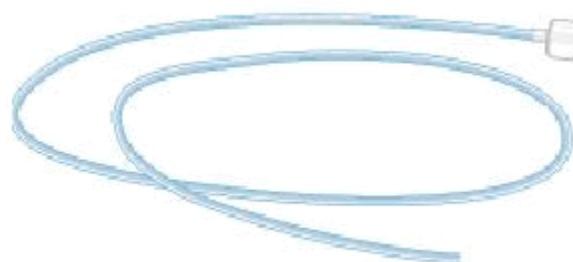
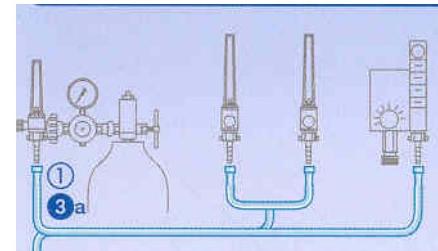
Setting up the Neopuff™

To check & set the Neopuff™ you will need:

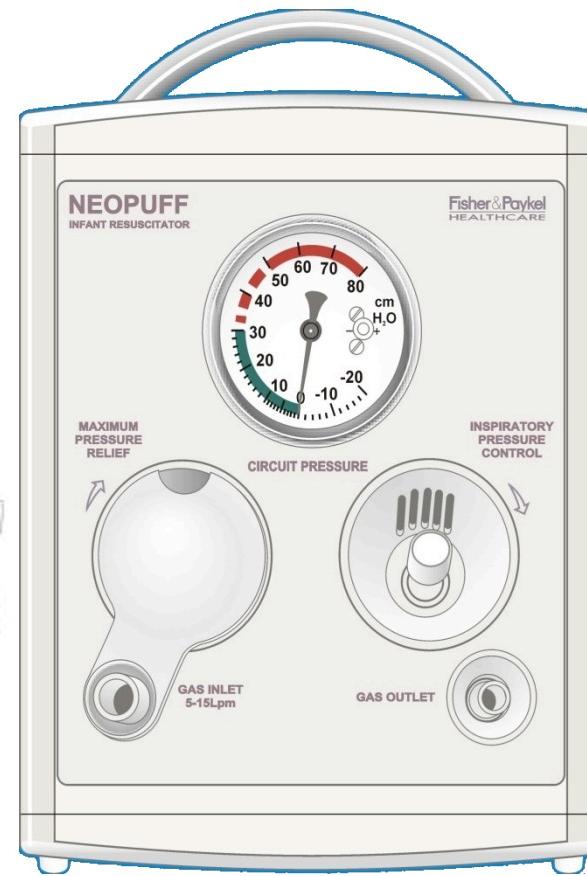
- A Neopuff™ Infant Resuscitator
- A compressed gas source
- A gas supply line (green oxygen tubing) with the plastic connector (supplied)
- The patient supply line (tubing & T-piece)
- A test lung

The components of the Neopuff™

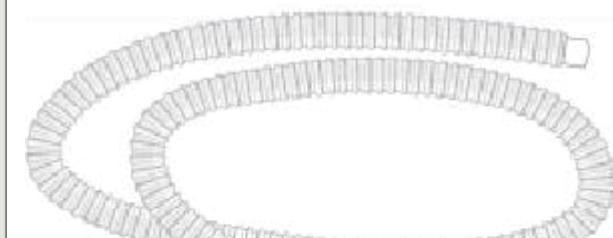
Gas supply



Gas supply line



Patient supply line with T-piece & mask



Test lung

Initial recommended settings

- Gas flow rate
 - Set at 10 L/min (8L /min if using cylinders)
- Maximum pressure relief valve
 - Set at 50 cm H₂O
- Peak inspiratory pressure (PIP)
 - Set at 30 cm H₂O (term newborn)
 - Set at 20 - 25 cm H₂O (preterm < 32 weeks')
- Positive end expiratory pressure (PEEP)
 - Set at 5 - 8 cm H₂O

(ARC & NZRC 2010: Guideline 13.4)

Setting up the Neopuff: 6 steps

Step 1

- Connect the gas supply line to the gas inlet & the patient supply line to the gas outlet

Step 2

- Attach a test lung to the patient supply line and turn the gas flow to 8 - 10 L/min

Step 3

- Check the maximum pressure relief valve is set to 50 cm H₂O (adjust as necessary)

Setting up the Neopuff: 6 steps

Step 4

- Set the peak inspiratory pressure (PIP) to 30 cm H₂O (term) or 20 – 25 cm H₂O (preterm)

Step 5

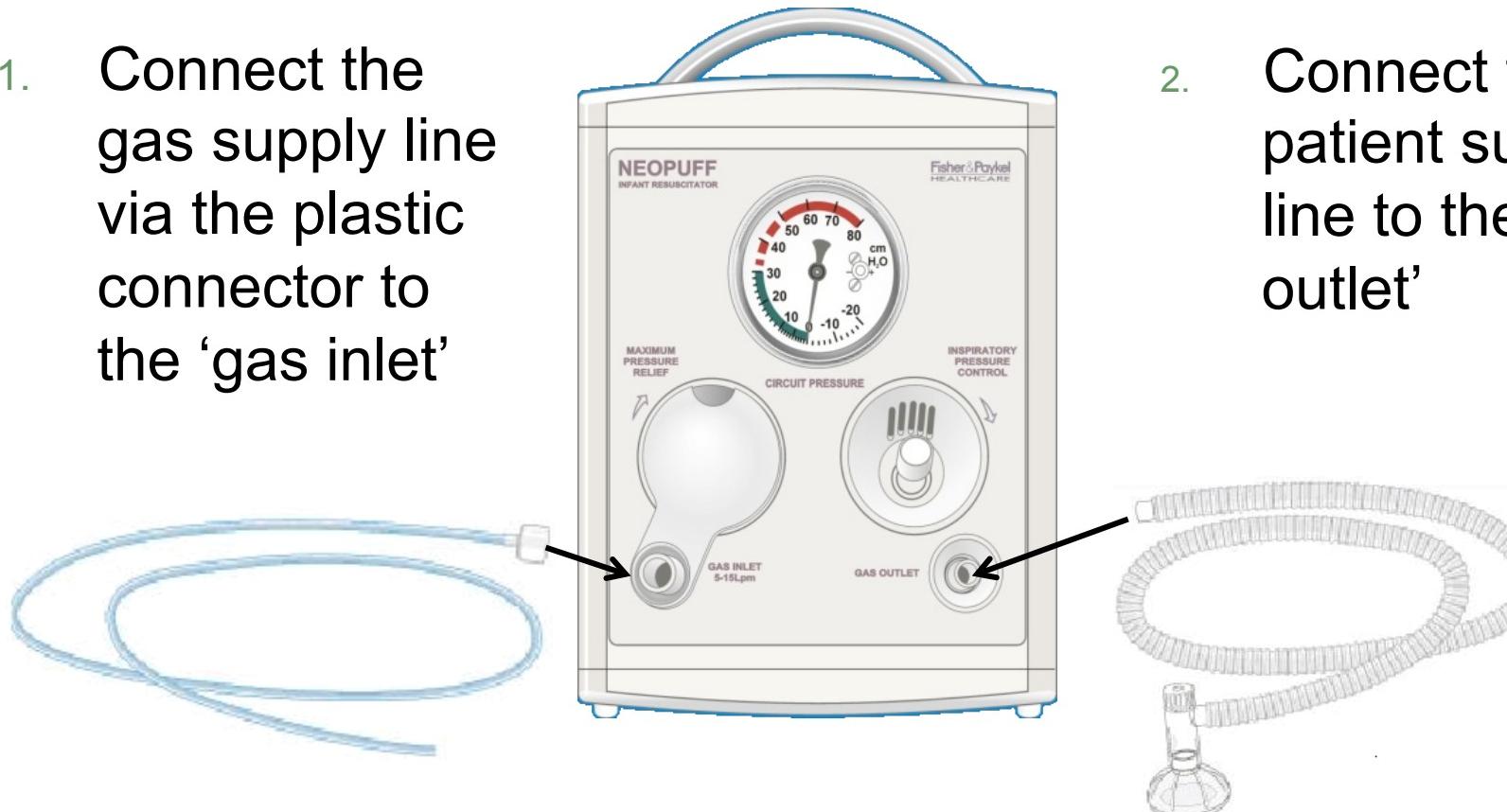
- Set the positive end expiratory pressure (PEEP) to 5 – 8 cm H₂O

Step 6

- Create a good seal between the infant's face & the face mask using the “two point top hold”

1. Connect the gas & patient supply lines

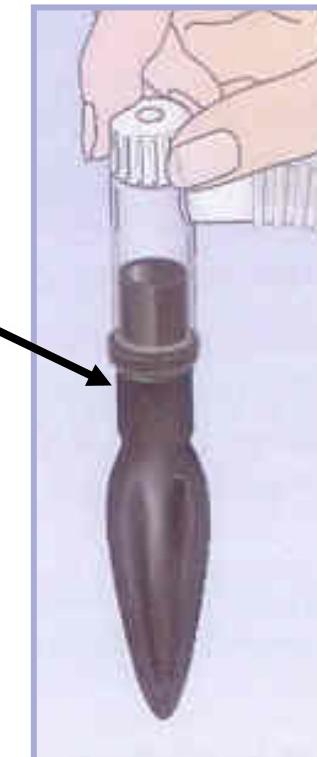
1. Connect the gas supply line via the plastic connector to the 'gas inlet'



2. Connect the patient supply line to the 'gas outlet'

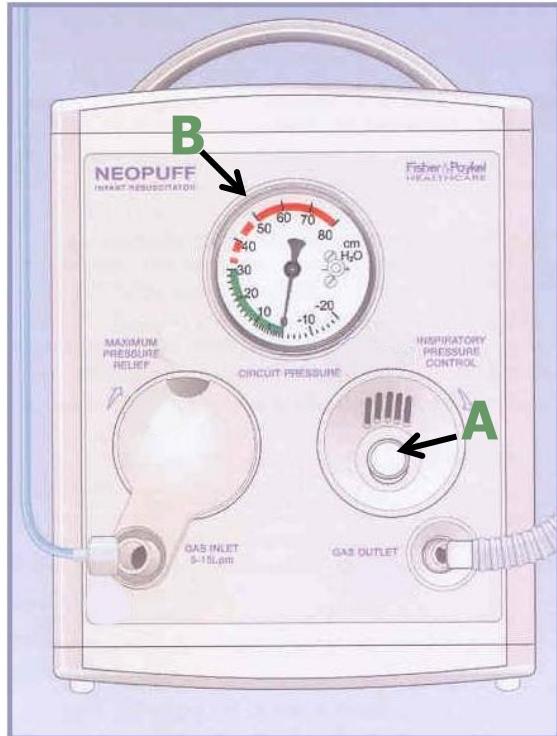
2. Attach the test lung

- Attach the test lung to the end of the patient supply line (patient T-piece)
- It is much easier to use the test lung (as opposed to a face mask or the ball of your hand) to set and test the Neopuff™
- Turn the gas flow to 8 - 10 L/min

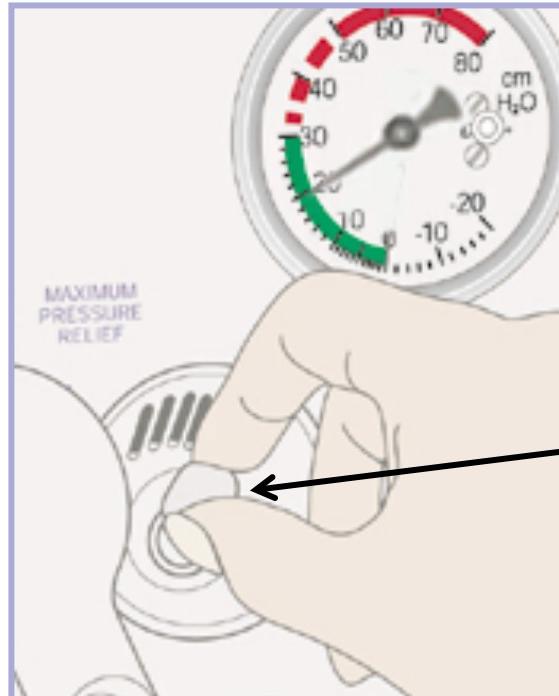


3. Check the maximum pressure has been pre-set to 50 cm H₂O

1. Turn the inspiratory pressure control dial fully clockwise until it cannot turn any further. **(A)**
2. Occlude the PEEP cap on the patient T-piece.
3. Look at the manometer & check that the pressure gauge points to 50 cm H₂O. **(B)** If it does, then the maximum pressure is set correctly. If it is not 50 cm H₂O, you will need to adjust it. (See following slide)



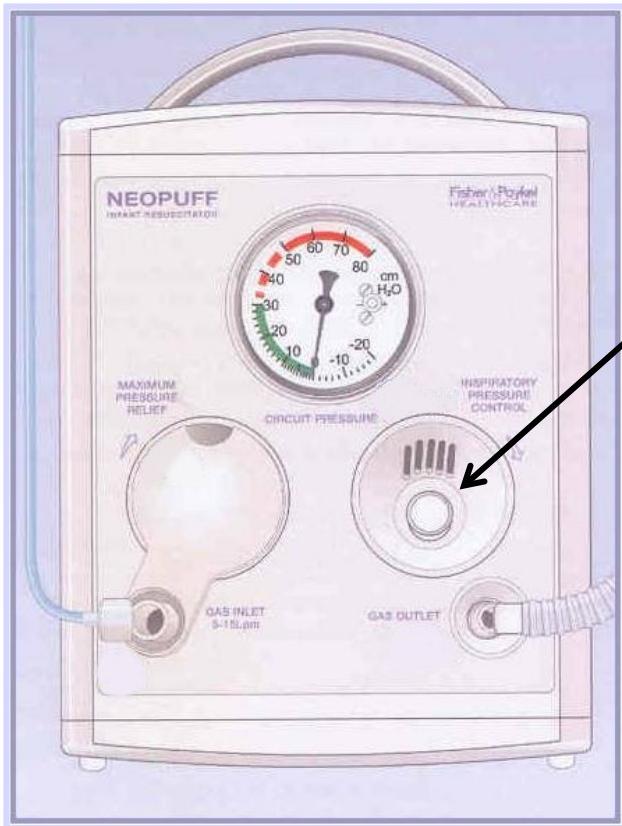
Adjusting the maximum pressure



Once the inspiratory pressure control dial is fully open:

1. Occlude the PEEP cap on the patient T-piece.
2. Open the cap covering the maximum pressure relief dial.
3. Turn the maximum pressure relief dial clockwise or anti-clockwise to adjust the maximum pressure to 50 cm H₂O.
4. Close the maximum pressure relief cap.

4. Set the peak inspiratory pressure (PIP)



1. Occlude the PEEP cap on the end of the patient T-piece.
2. Turn the inspiratory pressure control anti-clockwise (several times) to decrease the pressure from 50 cmH₂O down to the recommended PIP:
20 – 25 cm H₂O for a premature infant or 30 cm H₂O for a term infant.
3. The set PIP is displayed on the manometer when the PEEP cap on the patient T-piece is occluded.

5. Set the positive end expiratory pressure (PEEP)

- Set the PEEP by turning the cap on the patient T-piece clockwise or anti-clockwise until a PEEP of 5 cm H₂O is displayed on the manometer.
- **Caution:** If the PEEP has been set on a flow rate of 8 L/min, any increase in the flow rate will result in a dangerously high increase in PEEP. (Morley, Schmoelzer & Davis, 2009)
- If you increased the flow rate to 10 L/min, then re-set and re-check the PEEP.



6. Create a good seal between the infant's face & the mask

- Remove the test lung & attach a face mask to the patient T- piece.
- Position the infant's head in a neutral position.
- Place the third finger onto the chin tip (the “guide finger”).
- Line up the outer edge of the mask into the groove between the guide finger and the chin tip.
- Roll the mask onto the face from the chin upwards.

Holding the mask in place using the “two point top hold”

- Apply evenly balanced downward pressure onto the mask using the thumb and index finger positioned toward the outer edge of the flat area of the mask (“two point top hold”).
- Apply jaw lift with the remaining fingers so that the upward pressure works against the downward pressure from the two point top hold to create a good seal.



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Wood, et al. (2008).
Archives of Disease in Childhood, Fetal & Neonatal Edition 93: p. F231

Checking the face mask seal: “Listen & look” technique

- Leaks averaging 40 – 70% are common due to poor mask placement technique. Therefore:
 - Listen for a soft whistle of gas through the PEEP cap.
 - Look that a PEEP of 5 cm H₂O is displayed on the manometer.
- Be aware that a PIP of 30 cm H₂O may be reached on the manometer **despite a face mask leak of up to 90%**. (Wood, et al., 2008)

Delivering positive pressure inflations with the Neopuff™

- Occlude the PEEP cap using your thumb or finger for 0.5 seconds, then release for 0.5 seconds.
- This will provide a ventilation rate of 60 inflations per minute.
- Continue to check your mask seal by checking that the PEEP/CPAP returns to 5 cm H₂O on the manometer after each manual inflation.



Air or oxygen for resuscitation?

- Term newborns: Use air (21%) initially.
- Preterm newborns < 32 weeks: Use air or blended air and oxygen (21% to ~ 30% oxygen to start).
- Use air if a blender is not available.
- Supplemental oxygen should be used judiciously, ideally guided by pulse oximetry.

“The first priority is to ensure adequate inflation of the lungs, followed by increasing the concentration of inspired oxygen only if needed.”(ARC & NZRC², 2010, Guideline 13.4)



Target saturations for newborns during the first minutes after birth



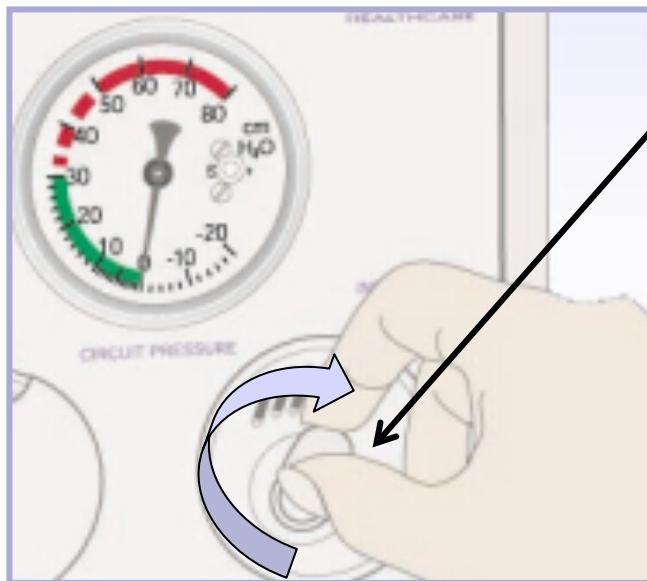
Time after birth in minutes	Targeted pre-ductal SpO ₂ after birth during resuscitation with supplemental oxygen
1 minute	60 – 70%
2 minutes	65 – 85%
3 minutes	70 – 90%
4 minutes	75 – 90%
5 minutes	80 – 90%
10 minutes	85 – 90%

ARC & NZRC², 2010, Guideline 13.4

Initial inflations

- Higher inflation pressures ($\text{PIP} > 30 \text{ cm H}_2\text{O}$) may be needed for the initial inflations.
- Subsequent inflations usually require less pressure, although some babies may need higher inflation pressures (higher PIP).
- **Improvement in heart rate** is the primary measure of adequate ventilation.
- If the heart rate is not improving with good technique, then higher PIP may be required.

Adjusting the PIP whilst using the Neopuff

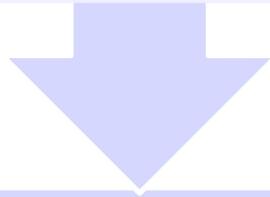


- Higher pressure inflations can be given by increasing the inspiratory pressure control to deliver higher PIP.
- This can be changed while resuscitating, but requires a second person to achieve this efficiently.

Common problems & solutions

Unable to achieve the desired PIP & PEEP when checking the Neopuff™ with the test lung

Check that the gas flow rate is set to 8 – 10 L/min and that there is gas flow through the Neopuff™ circuit



Still unable to achieve the desired PIP & PEEP when checking the Neopuff™ with the test lung

Check the maximum pressure relief is set correctly at 50 cm H₂O and adjust if necessary

Common problems & solutions

Unable to achieve the set PIP when ventilating the infant

Check the face mask seal using the “look and listen technique”



Still unable to achieve the set PIP

Reposition the infant’s head and apply the face mask again



Still unable to achieve the set PIP

Consider intubation if mask ventilation is unsuccessful

Most importantly: look at the infant, not at the manometer!

- Effective ventilation is confirmed by three signs:
 1. An increase in the heart rate above 100/minute.
 2. A slight rise of the chest and upper abdomen with each inflation.
 3. An improvement in oxygenation.
- Achieving the set PIP on the manometer is **not** a sign of effective ventilation.

Remember!

- If the heart rate remains < 100/min and/or the chest is not moving despite ventilating with good technique:

TURN UP THE PEAK PRESSURE (PIP)

$30 \rightarrow 40 \rightarrow 50 \rightarrow 60 \text{ cm H}_2\text{O}$

- Continue to provide positive pressure ventilation until the heart rate is above 100/min and the infant has established effective spontaneous respirations.
- Endotracheal intubation should be considered if ventilation via a face mask is unsuccessful.

References

- Australian Resuscitation Council & New Zealand Resuscitation Council. (2010). *Guideline 13.4: Airway management and mask ventilation of the newborn infant*. Accessed February 2, 2012 from <http://www.resus.org.au>
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- Morley, C.J., Schmolzer, G.M., & Davis, P.G. (2009). Potential hazards of the Neopuff: using appropriate gas flow. *Archives of Disease in Childhood- Fetal and Neonatal Edition*, 94, F467-F468.
- Wood, F.E., Morley, C.J., Dawson, J.A., Kamlin, C.O., Owen, L.S., Donath, S., & Davis, P.G. (2008). Improved techniques reduce face mask leak during simulated neonatal resuscitation. Study 2. *Archives of Disease in Childhood: Fetal & Neonatal Edition*, 93: F230 - F234.



Acknowledgements

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- The Neopuff colour diagrams have been reproduced with the kind permission of Fisher & Paykel Healthcare: Australia and New Zealand.

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